

WALLACE (A.R.)

MR. WALLACE AND MR. DARWIN.

A
REVIEW AND CRITICISM
OF
MR. DARWIN'S
"DESCENT OF MAN,"

BY
ALFRED RUSSELL WALLACE, F.R.G.S., &c.

AUTHOR OF
"TRAVELS IN THE MALAY ARCHIPELAGO,"
CONTRIBUTIONS TO THE THEORY OF NATURAL SELECTIONS,
ETC., ETC.

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MR. DARWIN'S reputation already stands so high that it may seem difficult to add to it. Yet this work will undoubtedly do so, and will prove almost equally attractive to the naturalist and the general reader. The two large volumes on *Domesticated Animals and Plants* caused some little disappointment to those who looked for easy scientific reading; but the present work will have no such drawback. It is throughout written in the author's clearest style, it is not overloaded with detail, it abounds in curious facts and acute reasoning, and it treats of two great subjects of the very highest interest—the nature and origin of man, and the overwhelming importance of sexual influences in moulding and beautifying the animal world.

The few passages devoted to sexual selection in the *Origin of Species*, led many persons to suppose that it was but a vague hypothesis

almost unsupported by direct evidence; and most of its opponents have shown an utter ignorance of, or disbelief in the whole matter. It will now be seen on what a solid foundation of fact the theory of sexual selection is founded, and how true, as regards this part of his subject at all events, was Mr. Darwin's assertion, that his first volume contained but a mere abstract of the evidence before him, and that he could not be properly judged till the whole mass of facts he had collected were made public. From the reticence with which the sexual relations of animals have been treated in popular works, most of the readers of this book will be astonished to find that a new and inner world of animal life exists, of which they had hitherto had no conception: and that a considerable portion of the form and structure, the weapons, the ornaments, and the colouring of animals, owes its very existence to the separation of the sexes. This new branch of natural history is one of the most striking creations of Mr. Darwin's genius, and it is all his own; and although we believe he imputes far too much to its operation, it must be admitted to have exerted a most powerful influence over the higher forms of life. In the first part of this article we propose to sketch in outline the main facts and arguments adduced, and shall afterwards discuss certain points which seem open to criticism.

Mr. Darwin tells us that he has for many

years collected the materials on which this work is mainly founded, without any intention of publishing them, as he did not wish to prejudice the reception of the general doctrine of natural selection. That doctrine has, however, made such rapid and unexpected progress that no danger of this kind any longer exists; and he has therefore put together his materials relating to the origin of man from a lower animal form. Believing that sexual selection has played an important part in differentiating the races of man, he has found it necessary to treat this subject in great detail, which has much increased the bulk of the work.

The first chapter discusses the evidence for the descent of man from some lower form. Not only is man's whole structure comparable, bone by bone and muscle by muscle, with that of other vertebrata, but his close relation to them is shown in a variety of unexpected ways. He is able to receive some animal diseases, as glanders, hydrophobia, &c., showing a close similarity to other animals in blood and tissues. The internal and external parasites of man are of the same families and genera as those of the lower animals. The embryonic development of man is exactly similar to that of other vertebrates, so that at an early period his embryo can hardly be distinguished from theirs; and arteries running in arch-like branches as if to carry blood to branchiæ which are not present in the higher animals,

show his affinity to the lower aquatic forms. A little later, the great toe is found standing out from the side of the foot, as it does in the quadrumana. Numerous rudiments occur in man of structures characteristic of lower forms. Many muscles regularly present in apes and other quadrupeds occasionally appear in man. The upper part of the infolded lobe of the ear often presents a pointed projection, the rudiment of the pointed and erectile ears of most mammals. The supra-condyloid foramen, through which the great nerve of the fore limb passes in quadrumana and carnivora, is absent in man; but it occasionally reappears, with the nerve passing through it: and a careful examination of the remains of prehistoric races shows, that this form was more frequent in ancient times than now.

The mental powers of man are then compared with those of the lower animals, and it is shown that the latter possess the rudiments of them all. The origin of the moral sense is next treated of; and although such eminent writers as Mill, Bain, Herbert Spencer and Sir John Lubbock have all given their independent theories on this subject, Mr. Darwin has hit upon a perfectly original view, which is perhaps more satisfactory than any which have preceded it. He maintains that the moral sense arises from the social instincts combined with an active intellect. As soon as the mental faculties became well developed,

images of past actions and motives would be incessantly passing through the mind of each individual, and a feeling of dissatisfaction would arise whenever it was perceived that the ever present social instinct had yielded to some other instinct stronger at the time but less enduring. For example, such instincts as hunger, lust, or the desire of vengeance are immensely strong but not enduring, and do not leave vivid and easily recalled impressions at all proportionate to their intensity at the time. The feeling of sympathy, the need of companionship, the desire for the approbation of our fellows are, on the other hand, ever present with us, and anything which interfered with these would be a constant source of dissatisfaction. If then a being with a sufficiently active mind to recall past actions and see the effects they have produced were, under the impulse of any of the stronger instincts, to rob, starve, kill or injure those who were necessary to the satisfaction of his social instincts, he would inevitably feel dissatisfied with himself at having allowed his passion for a temporary enjoyment, the force of which he could not realise afterwards, to interfere with the satisfaction of his less intense but more permanent desires and instincts. A repetition of such experiences would lead to the feeling that the one kind of instincts was less important to his welfare than the other. He would class them as passions to be regulated and controlled ;

and when in spite of his determination to control them he had not done so, he would almost despise himself—would feel remorse—would be rebuked by his conscience. Mr. Darwin shows at some length, that the rudiments of all these instincts and emotions exist in animals; and he argues that the acquisition of speech would greatly increase their power; for when each member of the community could express his feelings and wishes, the opinion of his fellows would go to increase the regret felt at having allowed the temporary to overcome the permanent instinct. The effect of this at first, would be to limit “virtue” to that which was for the benefit of the tribe exclusively. Murder, robbery and treachery within the limits of the tribe would be infamous, but beyond these limits might be even praiseworthy. Thus infanticide is so often not looked upon as a crime, because it is supposed to be beneficial to the tribe; and no pity has been felt for the sufferings of enemies, of slaves, or even of women. Owing to its great utility to the tribe, courage is always looked upon as the highest virtue; and for the same reason fidelity and self-sacrifice are always highly esteemed. But intemperance and licentiousness are never counted as vices, because they do not immediately concern any one but the individual and his family. Mr. Darwin concludes, that the moral sense is fundamentally identical with the social instincts, and has been devel-

oped for the general good of the community, rather than for its greatest happiness. "General good" is defined as "the means by which the greatest possible number of individuals can be reared in full vigour and health, with all their faculties perfect under the conditions to which they are exposed;" and it is quite conceivable that this may not be always identical with the "greatest happiness." If so, the present theory will be a step in advance in the history of the utilitarian philosophy.

The manner of development of man from some lower form is next very fully discussed. The extreme variability of every part of man's bodily structure and mental faculties is shown; the effect of changed conditions whether of locality or of habits is proved to be considerable; and arrested developments, reversions, and correlated variations are all shown to obtain in man exactly as they do in the lower animals. Natural selection must have acted on man, because he multiplies rapidly and beyond the means of subsistence, because he varies, and because he is exposed to varying external conditions; but Mr. Darwin adopts the views of the present writer, that as soon as man's mind had become moderately developed, the action of natural selection would have been checked, as regards his general structure, and transferred to his mental faculties. It is argued that the advance from animal to man must have taken place before the dispersal of the

race over the world ; and that in some warm country as large as Australia, New Guinea or Borneo, "the competition between tribe and tribe would have been sufficient under favourable conditions to have raised man through survival of the fittest, combined with the inherited effects of habit, to his present high position in the organic scale." A separate chapter is devoted to the development of man's intellect, and to the effects of natural selection on civilised nations ; and though many of the arguments used are open to criticism, the subject is most interesting, and is discussed with Mr. Darwin's usual clearness and candour.

The next two chapters discuss—the special affinities of man to certain lower animals, by means of which the line of his genealogy can be traced, and the place and time of his origin approximately determined—and the nature and probable origin of the several races of man. This last he believes cannot be fully explained without the agency of sexual selection, and this leads to the second part of the work, which treats of sexual differences, their causes and effects, throughout the animal kingdom, in order that the principles deduced from this extensive survey may be applied to explain certain residual phenomena in man.

The subject of sexual selection, occupying nearly five hundred pages, is treated in great

detail, and abounds in matter of interest ; but only a very brief sketch can here be given of it. The main theory depends upon the fact that there is almost invariably a struggle among the males for the females ; a struggle carried on either by actual fighting or by rivalry in voice or in beauty. This struggle is moreover ensured by the circumstance that in most cases the males are ready to breed before the females, male insects emerging sooner from the pupa, and male migratory birds arriving earlier than those of the other sex. From this it results that some males gain the victory over others, and succeed in pairing earlier and with the earliest and most vigorous females. The males are always the most eager, the females generally coy ; and Mr. Darwin believes that in almost all cases the female exerts a choice, and rejects those males who please her least. Hence have arisen two sets of modifications in male animals : 1. Weapons of various kinds have been developed, owing to those best able to fight having most frequently left progeny to inherit their superiority ; 2. Musical organs, bright colours, or ornamental appendages, have been developed, through the females preferring those so gifted or adorned. The laws of inheritance are first discussed ; the transmission of characters to the male alone through the female, and the transmission of variations at certain ages to the offspring

at the same age, and to one or both sexes. A large portion of the animal kingdom is then passed in review, as respects the differentiation of the sexes and the means by which such differentiation has been produced. This part of the work is illustrated by numerous woodcuts, showing the extraordinary differences of form and structure between the sexes. Many parts of the body have been modified to enable the male to seize and hold the female; and this is adduced as an argument that the female exerts a choice, and has the power of rejecting any particular male. But this hardly seems to follow, for it may well be maintained that when the more active male seizes a female, she cannot escape, and that she has no means of rejecting him and practically never does so.

The males of a considerable number of homopterous and orthopterous insects emit musical sounds by means of very curious and varied apparatus, and there is no doubt that these sounds serve to attract or charm the female. Among most insects the males fight, but neither spiders nor dragon-flies have been observed to do so. Among all other insects than lepidoptera, the sexes are as a rule coloured alike or nearly alike, the exceptions being comparatively few; but among butterflies especially, diversity of colour is the rule, the males being almost always most brilliantly or most intensely coloured; and the difference is often so great that the two sexes look like

widely different species. Beetles differ more in form than in colour, the males often possessing wonderful horns, spines, or protuberances, immensely long legs or antennæ, or enormous jaws, while in colour they hardly differ at all or are only somewhat brighter. Passing on to the vertebrates, we find that male fishes often fight, and exhibit as much ardour as terrestrial animals; some of them undergo strange changes of form at the breeding season, and some few differ conspicuously from the females in colour, or by the possession of elongated fins, spines, or other appendages. In other cases, although the sexes are usually alike, yet in the breeding season the males acquire new or more vivid colours.

Passing by amphibians and reptiles, among which many curious sexual characters occur, we come to birds, a class which exhibits them in their highest perfection, and which has furnished Mr. Darwin with the most powerful arguments for the complete development of his theory of sexual selection. Almost every imaginable kind of sexual ornament is here to be found. In an immense number of cases male birds are far more beautifully coloured than the females; and besides this, they often possess the most gorgeous developments of ornamental plumage, as in the train of the peacock, the wings of the African night-jar, the tail of the lyre-bird and of the resplendent trogon, the crest of the umbreila-bird, and the breast

plumes of the bird-of-paradise. Spurs are also developed upon the legs or the wings, and the male is generally larger, and has a louder or more melodious voice. Among birds is found the first direct proof that the female notices and admires increased brilliancy or beauty of colour, or any novel ornament; and, what is more important, that she exercises choice, rejecting one suitor and choosing another. There is abundant evidence too that the male fully displays all his charms before the females, and some of the facts adduced on this head are most curious and interesting. Mr. Darwin also devotes himself to showing how some of the most marvellous developments of beauty in plumage may have been produced by the constant selection of slight modifications; and he explains in this manner the origin of the eyed train of the peacock, and the wonderfully decorated wings of the Argus pheasant, with an acuteness and success hardly inferior to that which he exhibited when investigating the structure of coral reefs or of orchids. The four chapters on birds would alone demand a lengthy article to do them justice, but as we shall have to return to this subject when we come to criticise some portion of the theory, it will be as well now to pass over the two chapters on the sexual differences and weapons of the mammalia, and devote some little space to a sketch of the concluding chapters, which again treat of man.

The sexual differences of man are stated to be greater than in most species of quadumana, while in their general features and mode of development man agrees remarkably with those animals, as an example of which we may quote, that whenever the beard differs in colour from the hair on the head, it is always lighter, both in man and monkeys. The law of battle for wives still prevails among some savages, and to this circumstance Mr. Darwin thinks may be traced the undoubted inferiority of woman, not only in bodily strength but also in courage and perseverance, qualities equally necessary to ensure victory. He thinks also that but for the fortunate circumstance that the law of equal transmission of characters to both sexes has commonly prevailed among mammalia, man might have become as much superior to woman in mind as the peacock surpasses the peahen in plumage. Considerable space is devoted to prove that savages think much of personal appearance, admire certain types of form and complexion, and that probably selection of wives and of husbands has been an important agent in determining both the racial and the sexual differences of mankind. The evidence adduced, however, seems only to show that the men as a rule ornament themselves more than the women, and that they do so to be admired by their fellow-men quite as much as by the women; and also that men of each race ad-

mire all the characteristic features of their own race, and abhor any wide departure from it; the natural effect of which would be to keep the race true, not to favour the production of new races. It is admitted that promiscuous intercourse and infanticide would to a great extent prevent the action of sexual selection; but it would also be rendered nugatory by the fact that among savages no woman remains unmarried, youth and health being amply sufficient charms to procure her a husband. It also seems very uncertain whether any effect would be produced by the more powerful men possessing themselves of a number of the most beautiful women, and rearing on an average a greater number of children, as Mr. Darwin thinks they would do. Where polygamy prevails the number of children to one father may be very large, but will the number to each mother be as large as with the remainder of the tribe who are forced to practise monogamy? This important point is not alluded to. The absence of hair on the body is admitted to be a character that cannot be accounted for by "natural selection," because it cannot be conceived to have been a beneficial variation; but "sexual selection" is supposed to account for it. At an exceedingly early period of our history our semi-human ancestors were hairy, and it is thought that one or both sexes preferred less hair; and any partial nudity that appeared led to a

more early or a more constant wedlock, and thus gave an advantage to such individuals and their more numerous progeny. The example monkeys and apes is adduced, many of which have bare skin on the face or on other parts of the body; and the New Zealand proverb, "There is no woman for a hairy man," is thought to bear upon the question. This explanation is by no means satisfactory. The analogy of the quadrumana and of other animals would have some force if there were still hairy and hairless or partially hairless men,—with bare faces and breasts, but hairy backs, for example; but we have to deal with a complete nudity, which has no parallel in the animal kingdom except in cases where "natural selection" has evidently come into play. That a smooth-skinned race like the New Zealanders should object to hairiness is natural; for, as Mr. Darwin says, each race admires its own characteristics carried to a moderate extreme. Hairy races would therefore admire abundant hairiness, just as bearded races now admire fine beards; and any admiration of deficient hairiness would probably be as rare and abnormal as the admiration for partial baldness or scanty hair in women, would be among ourselves. Any individual fancy for such an abnormal peculiarity as deficient hair in a hair-covered animal could produce no effect; and that any such fancy should become general with our semi-human

ancestors, and so produce universal nakedness, does not seem at all probable, when we have no evidence of such a result of sexual selection elsewhere in the whole animal kingdom. It is true, that in the early state the struggle for existence would have been severe, and only the best endowed would have survived; but unless we suppose a universal and simultaneous fancy among all the most vigorous and therefore probably the most hairy men for what would be then an unnatural character—deficiency of hair in women—and that this fancy should have persisted in all its force for a long series of generations, it is not easy to see how this severe struggle for existence and survival of the fittest would in any way aid sexual selection in abolishing the hairy covering. On the contrary it seems more likely that it would entirely prevent it. We can hardly therefore impute much influence to sexual selection in the case of man, even as regards less important characters than the loss of hair, because it requires the very same tastes to persist in the majority of the race during a period of long and unknown duration. All analogy teaches us that there would be no such identity of taste in successive generations; and this seems a fatal objection to the belief that any fixed and definite characters could have been produced in man by sexual selection alone.

In his last chapter, Mr. Darwin gives an

able summary of the whole argument; and, while regretting that the result he has arrived at will be highly distasteful to many persons, maintains that the whole evidence leads to the conclusion that man, notwithstanding his noble qualities and his god-like intellect, still bears in his bodily frame the indelible stamp of his lowly origin.

Having thus sketched in outline the theories advanced by our author, and given a summary of facts by which he supports them, we have now to notice in more detail certain portions of the argument which appear to rest upon an insecure foundation either of logic or of fact.

The first and most obvious objection that will be made to this great work is that it consists of two books mixed together. The whole of the matter relating to sexual selection among animals, would have formed a fitting third volume in the series of works treating in detail of the origin of species; while the part which treats of man, is an application of those principles to the human race which had hitherto only been discussed as regards other animals and plants, and would have formed a fitting companion volume to the *Origin of Species*. This rearrangement could easily be effected in a future edition, and would have many advantages; and should a similar suggestion come from other quarters we hope Mr. Darwin will adopt it.

In entering upon a criticism of some por-

tions of these volumes, I am compelled to touch upon certain topics on which I hold, and have published, views differing considerably from those maintained by Mr. Darwin; and I am glad to have this opportunity of showing to what extent a study of his facts and arguments have modified my opinions. Before plunging into the intricate subject of "sexual selection," I must however, make a few remarks on Mr. Darwin's use of the same term "instinct" for what seem to me very distinct things. He classes as instincts, hunger, self-preservation, the mother's love of her offspring, and the infant's power of sucking. The first is a sensation, the second acquired habit, the third an emotion, the fourth a pleasurable exercise of certain muscles—none of them instinct in the same sense as the cause of the migration of birds, of the building of platforms by apes, of the avoidance of poisonous fruits or the dread of snakes—all of which are specially mentioned as instincts. To go into the question of which of these latter are acquired habits or acquired knowledge, and which are truly instinctive, would lead us too far; but it is certainly not in accordance with our author's usual precision of language on other topics, to use the same term for a simple sensation like hunger—for a faculty which may be experience or may be simple dislike acquired by natural selection, like the avoidance of poisonous fruits—and

for all the mental processes involved in a highly complex operation like that of the construction of a bird's nest. It is no doubt mainly due to the poverty of our language that one word has been used for so many distinct things; but as long as this is the case it is hardly possible to avoid confusion of ideas about instinct.

In discussing the subject of sexual selection it would perhaps have been a more convenient, even if a less scientific arrangement, to have treated first of those groups in which the evidence is clearest and most decisive; for Mr. Darwin is often obliged to refer to these in advance to strengthen his argument in the case of those inferior groups in which it is much more difficult to obtain evidence. I shall therefore first consider what is proved in the case of birds.

In birds sexual differences are both more generally the rule and more wonderfully varied in character than any other class of animals. The males sometimes possess special weapons for fighting together; more frequently they charm the female by vocal or instrumental music; more frequently still they are ornamented with all sorts of crests, wattles, horns, air-sacs, plumes, and lengthened feathers, springing from all parts of the body. They are extremely pugnacious; they sing in rivalry, and they perform the most extraordinary antics and dances during the breeding

season, exhibiting in the most curious and often unexpected manner all their peculiar adornments before the female. It is proved that in many cases they have a taste for colour and for novelty; and some female domestic birds are shown to have had such a fondness for a peculiarly colored male as to refuse to pair with any other. When in addition to this we consider that many birds are polygamous, and that in these the sexual differences are almost always greatest, we must admit that sexual selection would necessarily produce an effect in developing weapons, musical organs, or ornaments in one or both sexes. But while sexual selection has thus been doing its work, the still more powerful agency of natural selection has not been in abeyance, but has also modified one or both sexes in accordance with their conditions in life; and these in the case of birds are somewhat different in the two sexes. Whole groups of birds are evidently colored for protection, resembling the desert sands, or the green leaves, or the arctic snows, among which they live; and as we may be sure that variations tending to other colours have appeared in these birds, and as we have no reason to believe that in these groups only the females have been indifferent to such adornment, we must admit that natural selection has here checked the action of sexual selection. There are, however, an immense number of birds in which the female

only is of dull brown or green tints, while the male is adorned with the most splendid colours; and there are also a very large number in which both sexes are equally or almost equally brilliant; and, with very rare exceptions, the rule is found to hold that the former class all build open nests, the latter all covered or hidden nests. The bright-coloured female birds are thus concealed while incubating, the dull-coloured are exposed. This very curious relation appeared to me to indicate that natural selection had been more powerful than the laws, whatever they are, which primarily determine the colours of birds; that the females had in one case been prevented from acquiring any considerable portion of the gay colouring of the males because it was hurtful to them, and in the other case had acquired it because, being concealed during incubation, it was no more hurtful to them than to the males. Mr. Darwin objects to this explanation of the facts. He maintains that the "laws of inheritance" determine whether colour or any other ornament appearing in one sex shall be transmitted to that sex only or to both. So far there is nothing to object to. But he goes further, and maintains that this tendency cannot be affected by natural selection, and that if a particular colour-variation begins to be transmitted to both sexes, the mode of transmission cannot, by natural selection, be changed, so that the colour may continue to be transmitted

to the male, to whom it is useful, but cease to be transmitted to the female, to whom it is hurtful. Mr. Darwin admits that the law itself varies very frequently; for he gives numerous instances in which the different species of a genus exhibit all the possible modes of transmission, and as these have all descended from a common ancestor, the law has varied somewhat rapidly. He also says, "The equal transmission of characters to both sexes is the commonest form of inheritance," and we may therefore fairly assume that before diversity arose between the sexes, it was the rule for both sexes to vary together. But he believes that, under these circumstances, it would be exceedingly difficult for natural selection to change the male alone, and he gives an imaginary illustration to exhibit this difficulty. He supposes a fancier to wish to make a breed of pigeons in which the males should be pale blue, the females remaining the usual slaty colour; and he says, "All that he could do would be to persevere in selecting every male pigeon which was in the least degree of a paler blue, and to match these with slaty females, the result being, of course, "either a mongrel piebald lot or more probably the speedy and complete loss of the pale blue colour." But the supposed fancier has here gone quite the wrong way to work. His primary want is, not "blue males," but a breed in which there is a tendency to *differentiation of sex*. His

proper plan, therefore, would be to look over as many sets as possible of the progeny of single pairs of pigeons till he found one in which *a differentiation of sex appeared in the right direction*, the males being lighter, the females darker, in however slight a degree. Breeding from these again, he would probably in a few generations find a greater differentiation occur, for we know that such changes in the mode of transmission have often occurred in nature; and only when he had obtained a breed in which the sexes were strongly differentiated, variations of colour occurring frequently in the male sex, rarely or not at all in the female, would it be advisable for him to begin selecting for the exact tint of colour he desired in his males. Now, though nature may often do more in the way of selection than man, we can hardly believe that anything can be done by man's selection which may not be done as effectually by natural selection; and as it is admitted that the dull colours of the females sitting on open nests are a protection to them, and also that variations in the mode of transmission frequently occur, what is to prevent the females being modified in the way most advantageous to them for protection, while the males are being modified in the way most advantageous to them, by sexual selection? When the males of a species began to gain bright colours by selection, and these colours were transmitted to the females till

they became injurious, it may be fairly assumed that they would be transmitted in somewhat varying degrees, for Mr. Darwin states (p. 177, vol. ii.), that the degree of limitation differs in species of the same group; and as from mere association in the same locality individuals of the same family have a good chance of breeding together, the less brilliant females and more brilliant males of such families would often produce offspring in which the sexual differences were still greater, and these would have the best chance of surviving again to leave offspring. It is true that brilliant males of the same stock with brilliant females would have an equal chance of leaving descendants, but as the females of their families would be at a great disadvantage, and would less frequently rear offspring, while the males of the differentiated families would be protected, the latter would soon be in a majority of two to one, and must inevitably supplant the former. This view enables us to understand many facts given by Mr. Darwin which seem difficulties on his own hypothesis. Thus the sexes of *Culicidæ* and *Tabanidæ* among flies, differ in the structure of the mouth in accordance with difference of habits; some male *Cirrhipedes* have lost almost all their external organs, while the female has retained hers; and female glow-worms, as well as many female moths, have lost their wings. Such varied adaptations of one sex alone could only

occur if the rule were almost universal, that variations were limited to the sex in which they originally appeared; but we have seen that the contrary is nearer to the truth, and it seems more probable that the phenomenon of strictly limited sexual transmission was actually produced by natural selection as soon as the need arose for a differentiation of the sexes in organization, habits, or economy, than that it is an independent law. It evidently could have been so produced as well as the primary separation of the sexes which Mr. Darwin does not seem to doubt was effected by means of natural selection; and he appears to be unnecessarily depreciating the efficacy of his own first principle when he places limited sexual transmission beyond the range of its power.

Passing now to the lower animals—fishes, and especially insects—the evidence for sexual selection becomes comparatively very weak; and it seems doubtful if we are justified in applying the laws which prevail among the highly organized and emotional birds, to interpret somewhat analogous results in their case. The rivalry between males, either by fighting together or by emitting attractive sounds or odours, undoubtedly acts in the case of insects as well as in the higher animals; but it is quite different with the other form of sexual selection. This depends upon the appreciation of slight differences of colour by the female, and

also by her having the power as well as the will to reject such males as are slightly inferior in attractions; and on both these points there is no direct evidence but what tells against Mr. Darwin's view. Thus, he informs that "fresh females are often found paired with battered, faded, or dingy males," and breeders agree that in the case of the various silk-moths the female exerts no choice whatever, Dr. Wallace, of Colchester, stating that he frequently finds the most vigorous females of *Bombyx Cynthia* paired with stunted males. But the Bombyces are among the most elegantly colored of all moths.

From the fact that many male butterflies may be seen pursuing or crowding round the same female, Mr. Darwin concludes that the females prefer one male to another, because, if this was not the case, the pairing must be left to mere chance, and this does not seem to him a probable event. But surely the male who finally obtains the female will be either the most vigorous, or the strongest winged, or the most patient of the two or three suitors—the one who tires out or beats off the rest. The pairing, therefore, will not be left to chance, and it is probably by such struggles that the males of almost all butterflies have been rendered much stronger-winged than the females. Throughout the whole of the other orders of insects there is no direct evidence whatever of sexual selection as regards colour; for the

colours are generally similar in both sexes, and the particular colours that occur seem to be often determined by the greater or less need of protection. Thus the stinging Hymenoptera are, as a rule, conspicuously coloured; as are large numbers of the Hemiptera, which are protected by their disgusting odour. Coleoptera are almost all palpably protected, either by resembling inanimate objects, by obscurity, by hard coats of mail, or by being distasteful to birds; and those of the two latter categories are almost all conspicuously coloured. It seems to me, therefore, much more probable that the colours of insects are due to the same unknown laws which have produced the colours of caterpillars, than that they are due to sexual selection. In caterpillars we have almost all the classes of coloration found in perfect insects. We have protective and conspicuous tints; and among the latter we have spots, streaks, bands, and patterns, perfectly definite in character and of the most brilliantly contrasted hues. We have also many ornamental appendages; beautiful fleshy tubercles or tentacles, hard spines, beautifully coloured hairs arranged with tufts, brushes, starry clusters, or long pencils,—and horns on the head and tail, either single or double, pointed or clubbed. Now, if all these beautiful and varied ornaments can be produced and rendered constant in each species, by some unknown cause, quite independent of sexual selection, why cannot

the same cause produce the colours and many of the ornaments of perfect insects, subjected as they are to so much greater variety of conditions than their larva? In the case of butterflies it is a curious fact that the females are often much more variable than the males. The females of *Papilio*, *memnon* and *Diadema auge* are perhaps the most variable of all butterflies, consisting of scores of such different insects that they have over and over again been described as distinct species, while in both cases the males are very constant. Had the males been differentiated by sexual selection we should have expected them to be more variable, as they always are amongst insects as regards largely developed jaws, horns, or other weapons undoubtedly used for sexual purposes. In many groups of butterflies, too, the males of the different species of a genus closely resemble each other, while the females differ considerably, so that it often happens that forms considered to be mere varieties as long as the males only are known, become recognized as good species when the females are discovered. This is the case generally in *Ornithoptera*, several groups of *Papilio*, *Adolias*, *Diadema*; and it is so exactly the reverse of what obtains in birds that we must hesitate to apply the same explanation to the two sets of phenomena.

There are two other difficulties in the way of accepting Mr. Darwin's wide generalization

as to agency of sexual selection in producing the greater part of the colour that adorns the animal world. How are we to believe that the action of an ever varying fancy for any slight change of colour could produce and fix the definite colours and markings which actually characterize species. Successive generations of female birds choosing any little variety of colour that occurred among their suitors would necessarily lead to a speckled or piebald and unstable result, not to the beautifully definite colours and markings we see. To the agency of natural selection there is no such bar. Each variation is unerringly selected or rejected according as it is useful or the reverse; and as conditions change but slowly, modifications will necessarily be carried on and accumulated till they reach their highest point of efficiency. But how can the individual tastes of hundreds of successive generations of female birds produce any such definite or constant effect? Some law of necessary development of colour in certain parts of the body and in certain hues is first required, and then perhaps, in the case of birds, the females might choose the successive improvements as they occurred; though, unless other variations were altogether prevented, it seems just as likely that they would mar the effect the law of development of colour was tending to produce.

The other objection is, that there are signs of

such a tendency, which, taken in connection with the cases of caterpillars, of shells, and other very low organisms, may cover the whole ground in the case of insects, and render sexual selection of colour as unnecessary as it is unsupported by direct evidence. In many islands of the Malay Archipelago, species of widely different genera of butterflies differ, in precisely the same way as to colour or form, from allied species in other islands. The same thing occurs to a less degree in other parts of the world. Here we have indications of some local modifying influence which is certainly not sexual selection. So, the production in the males only of certain butterflies, of a peculiar neururation of the wings, of differently formed legs, and especially of groups of peculiarly formed scales only to be detected by microscopical examination, indicate the existence of some laws of development capable of differentiating the sexes other than sexual selection.

On the whole, then it seems to me, that the kind of sexual selection which depends on the female preferring certain colours or ornaments in the male, has not been proved to exist in insects. Their colours are probably due to some as yet unknown causes; the differences of the sexes consisting, partly of a greater intensity of colouring in the male, due, perhaps, to his smaller size and greater vigour, and partly of more or less protective tints acquired

by the female alone on account of her slower flight and greater need for protection, while depositing her eggs. Many other points of great interest must be passed over, but sufficient has been said to enable the reader fairly to compare the facts and arguments previously adduced by myself, with those now set forth by Mr. Darwin, and to form a judgment as to the comparative importance to be attached to sexual selection and the need of protection, in determining the sexual differences of colour in animals.

Having in the first part of this article made some objections to the theory of sexual selection in its application to man, I will now briefly notice Mr. Darwin's account of the probable mode in which man became developed from his brute ancestor. All the evidence goes to show, that the change from brute to man took place in some limited area, probably tropical. Here he lost his hairy covering, acquired his erect form and his wonderful brain, and became so far advanced in the arts and in morals that natural selection ceased to act upon his mere bodily organization. It is also probable that he learnt to speak language, discovered the use of fire, and perhaps even of canoes, before he spread over the earth, and before the several races of man were differentiated. The agency through which this vast transformation occurred was the struggle for existence and natural selection—a struggle first with other

animals, and when they were surpassed between tribe and tribe; and this alone Mr. Darwin thinks would, under favorable conditions, raise man to his present high position in the organic scale.

In this view there are many difficulties. How is it possible to conceive, that during the enormous interval required to change a quadrumanous, hairy, speechless animal, into erect, smooth-skinned, large-brained, fire-using man, while the struggle for existence was most severe (for by the severity of the struggle alone he was raised), he yet never spread over the earth but remained concentrated in a limited area. Had he spread widely during the process of modification, divergence of character would inevitably have occurred, and we should have had several distinct species of man. Mr. Darwin argues that the fact of man, even at his lowest stage of civilization and intellect, being able to maintain himself, surrounded by the most powerful and ferocious animals, is due to his large brain, which is thus of the most essential use to him. But almost all herbivorous animals also maintain themselves under similar conditions, with no special endowment of brains; and in South America the apparently helpless and almost idiotic sloth is not exterminated, though exposed to the attacks of pumas, tiger-cats, and harpy-eagles. Man could have acquired very little of his superiority to animals by a

struggle with animals. "Natural selection does not produce absolute perfection but only relative perfection." We have to fall back therefore on the struggle with his fellows—family with family, tribe with tribe. But for this to be at all effectual, one of the most essential conditions is a large population inhabiting an extensive area, and this the conditions of the problem deny to us. The vast amount of the superiority of man to his nearest allies is what is so difficult to account for. His absolute erectness of posture, the completeness of his nudity, the harmonious perfection of his hands, the almost infinite capacities of his brain, constitute a series of correlated advances too great to be accounted for by the struggle for existence of an isolated group of apes in a limited area. And Mr. Darwin himself gives hints of unknown causes which may have aided in the work. He says: "An unexplained residuum of change, perhaps a large one, must be left to the assumed uniform action of those unknown agencies which occasionally induce strongly marked and abrupt deviations of structure in our domestic productions." And again: "if these causes, whatever they may be, were to act more uniformly, and energetically during a lengthened period (and no reason can be assigned why this should not sometimes occur), the result would probably be, not mere slight differences, but well marked, constant modifications."

In concluding this very imperfect account of one of the most remarkable works in the English language, it may be affirmed, that Mr. Darwin has all but demonstrated the origin of man by descent from some inferior animal form—that he has proved the vast importance of sexual influence in modifying the colours and the structure of the more highly organized animals—and that he has thrown fresh light upon the intricate question of the mode of development of the moral and intellectual nature of man. Yet it must be admitted that there are many difficulties in the detailed application of his views; and it seems probable that these can only be overcome by giving more weight to those unknown laws whose existence he admits, but to which he assigns an altogether subordinate part in determining the development of organic forms.

ALFRED R. WALLACE.

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